Automatic Configuration Deployment Using Cisco Configuration Engine (CCE)

BRKNMS-2784

Agenda

- What Is Cisco Configuration Engine?
- Cisco Configuration Engine Architecture
- Network and Device Configuration Requirements
- Configuration Deployment Process using CCE
- CCE Deployment Considerations
- Templates Overview
- Sample Templates
- Integration Through Webservice APIs
- Case Studies
- Demo

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What Is Cisco Configuration Engine

- Cisco Configuration Engine is

  Scalable and flexible application designed to automate Configuration and Image deployment to large number of devices quickly and efficiently

- Who could benefit from this application

  Service Providers—for consistent and large scale deployment of Customer Premise Equipments (CPE), automatic turn up of services and efficiently handle Moves, Adds, Changes, and Deletes

  Large and Medium Enterprises—for deployment of routers in with consistent configuration which are geographically dispersed. Efficiently handle any large scale configuration changes and Image management

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Product Features

Secure and Scalable	▪ Scalable up to 30,000 CPE devices on single server ▪ Secure deployment and management over SSL
Zero-Touch Service Deployment	▪ Significant reduction in time to roll out new service through elimination of staging and manual processes
Configuration Services	▪ Configuration update to one or a group of devices ▪ Email and e-page notification of outcome
Image Services	▪ Policy-based validation of device resources ▪ Support for devices behind firewall and dynamic IP addressing
Web-Based GUI	▪ Feature-rich Web GUI that enables customers to use the product without additional configuration
Velocity Template Engine	▪ Customizable to meet customers' business and operation requirements ▪ Work flow control and support for scripts
Web Services	▪ XML and Simple Object Access Protocol (SOAP) Web Service Description Language (WSDL) available for all features supported from the Web GUI

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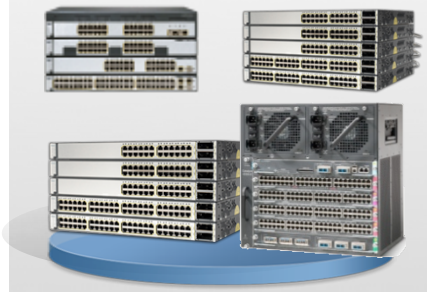
Cisco Configuration Engine: Supported Platforms

Access Routers

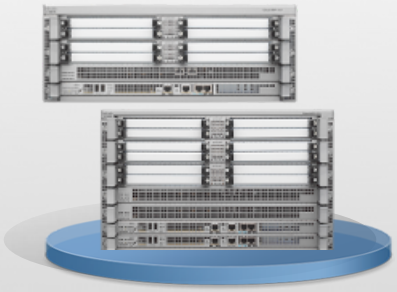
- Cisco 800 Series
- Cisco 1800 Series
- Cisco 2800 Series
- Cisco 3200 Series
- Cisco 3800 Series
- Cisco SOHO 70 and 90 Series
- Cisco 1700 Series
- Cisco 2600 Series
- Cisco 3600 Series
- Cisco 3700 Series
- Cisco Unified Communications 500 Series
- Cisco 500 Series Secure Routers

Access and Metro Switches



- Cisco Catalyst 2950
- Cisco Catalyst 2960
- Cisco IE3000
- Cisco Catalyst 3550
- Cisco Catalyst 3560
- Cisco Catalyst 3560-E
- Cisco Catalyst 3750
- Cisco Catalyst 3750-E
- Cisco ME 3400 Series
- Cisco ME 3400E Series
- Cisco Catalyst 4500
- Cisco ME 4900 Series
- Cisco Catalyst 6500

Aggregation Routers



- Cisco 7200 Series
- Cisco 7300 Series
- Cisco 7500 Series
- Cisco ASR 1000 Series
- Cisco 7600 Series
- Cisco 10000 Series
- Cisco 10700 Series
- Cisco 12000 Series

Voice and Wireless

- Cisco AS5300 Series
- Cisco AS5400 Series
- Cisco AS5800 Series
- Cisco IAD2400 Series
- Cisco IAD880 Series
- Cisco MWR 1900
- Cisco MWR 2900

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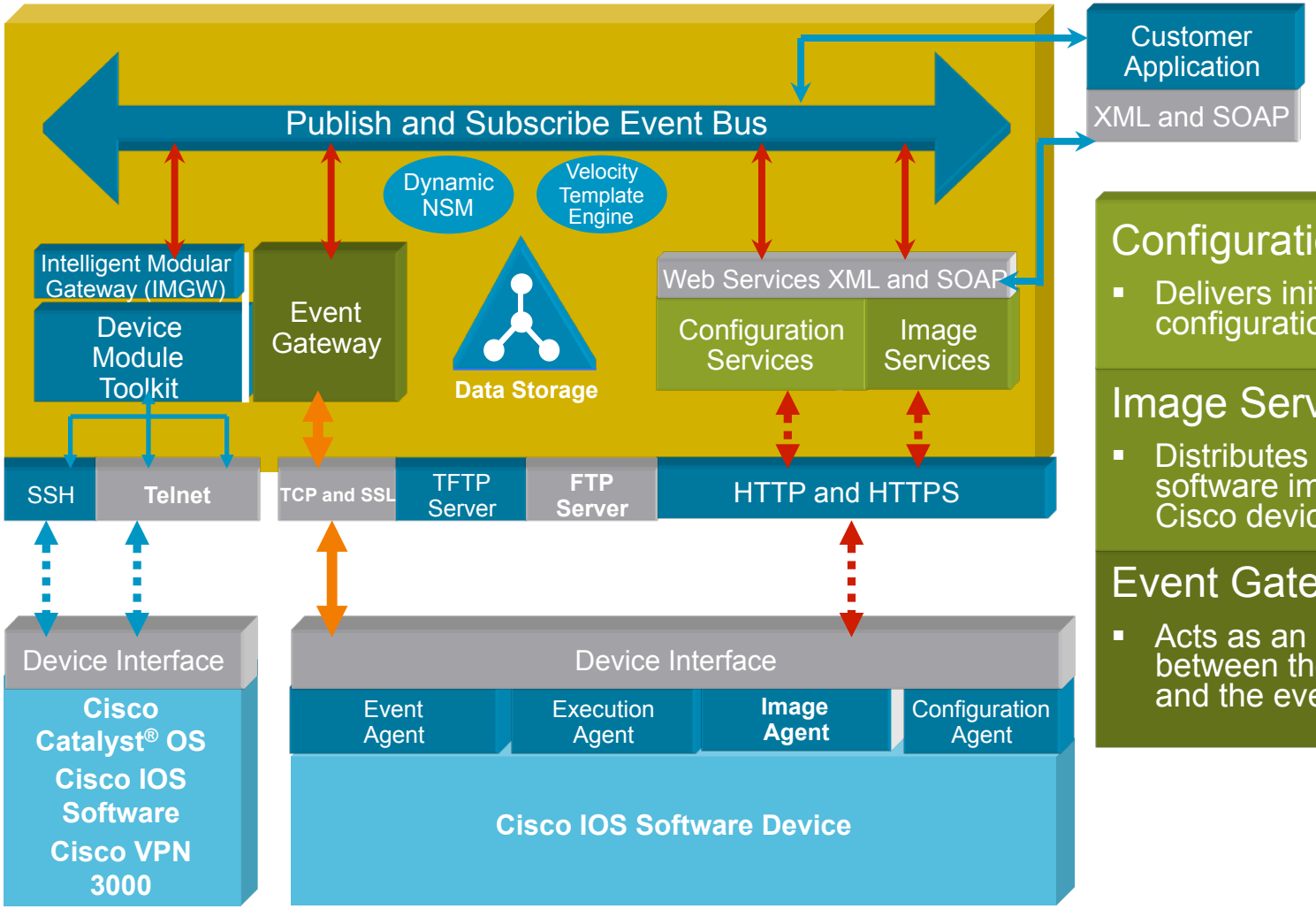
CCE System Architecture



Configuration Service

- Delivers initial and partial configuration

Image Service

- Distributes and activate software image to Cisco devices

Event Gateway

- Acts as an interface between the devices and the event bus

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Required Bootstrap Configuration

What is a Bootstrap Configuration?

Bootstrap configuration is initial set of dynamic startup configuration commands

- Specific to the customer
- Service, location, etc., agnostic

Configuration for Secure Mode of Operation

```
crypto ca trustpoint corp.abc.com
enrollment mode ra
enrollment url ftp://<ftp-user>:<ftp-password>@<cert-
server>/<signed-certificate>.crt
usage ssl-client
revocation-check none
!
crypto ca authenticate corp.abc.com
!
cns password <challenge-password>
!
cns trusted-server all-agents <CCE-Server>
cns id hardware-serial
cns id hardware-serial event
cns id hardware-serial image
cns event <CCE-Server> encrypt <Event Gateway Port>
keepalive 60 3
cns config initial <CCE-Server> encrypt 443 inventory
!
cns image server https:// <CCE-Server>:443/cns/
HttpMsgDispatcher status
https:// <CCE-Server> :443/cns/HttpMsgDispatcher
!
cns inventory
 transport event
 announce config
cns exec encrypt 443
```


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Preparing the Configuration Engine
Device ID and Configuration Template

Set up device in Cisco Configuration Engine before device deployment

- Add device ID: Unique device identifier

  Device ID can be hostname, IP address, MAC address, hardware serial number, unique device identifier (UDI)), or any string

- Associate configuration template with device

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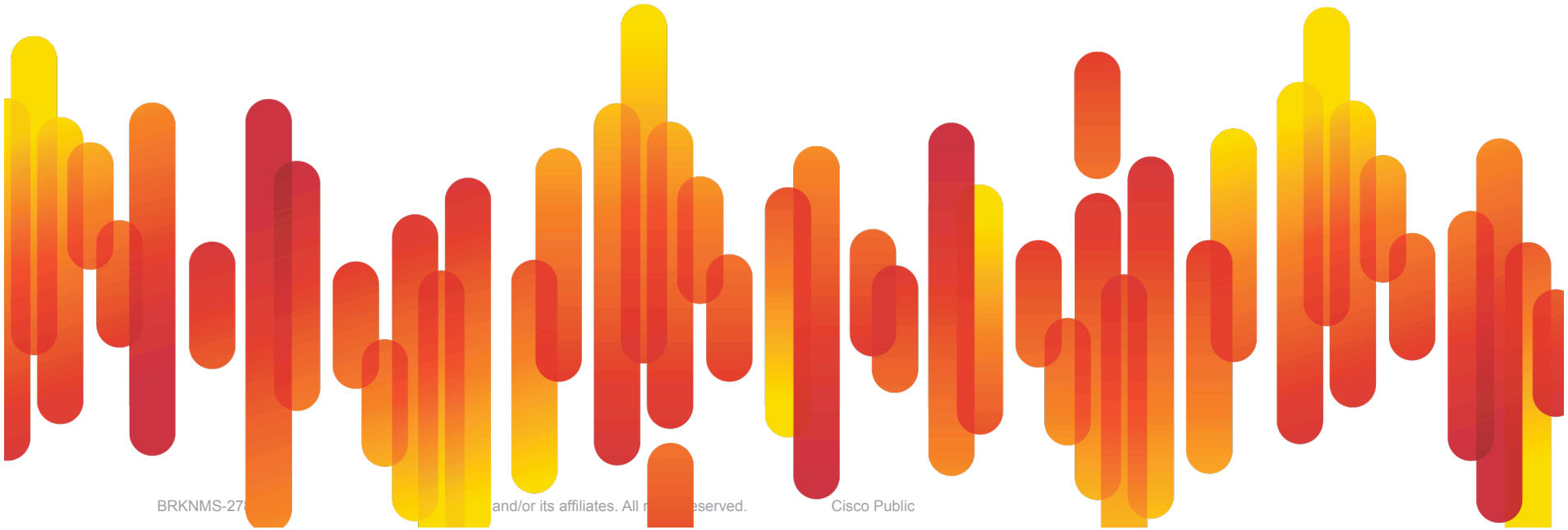
Deployment of CPE using CCE



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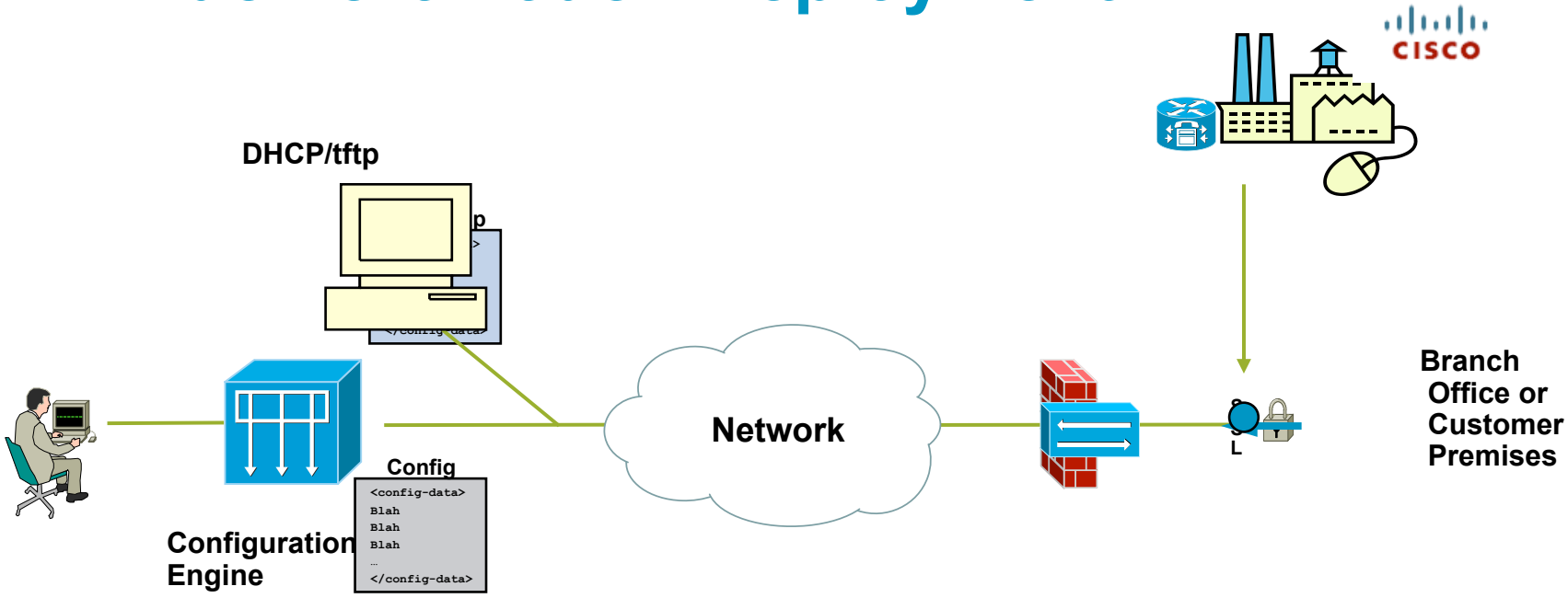
Deployment Model with CCE
True Zero Touch Deployment



1. Device shipped from Cisco manufacturing to branch with no config.
2. CE is notified to add the device and associated with a configuration template
3. Device is connected and initiates DHCP/TFTP requests for bootstrap
4. Device loads bootstrap, initiates connection to CE
5. CE identifies the device and sends the full configuration to the device, config agent loads the configuration, device operational

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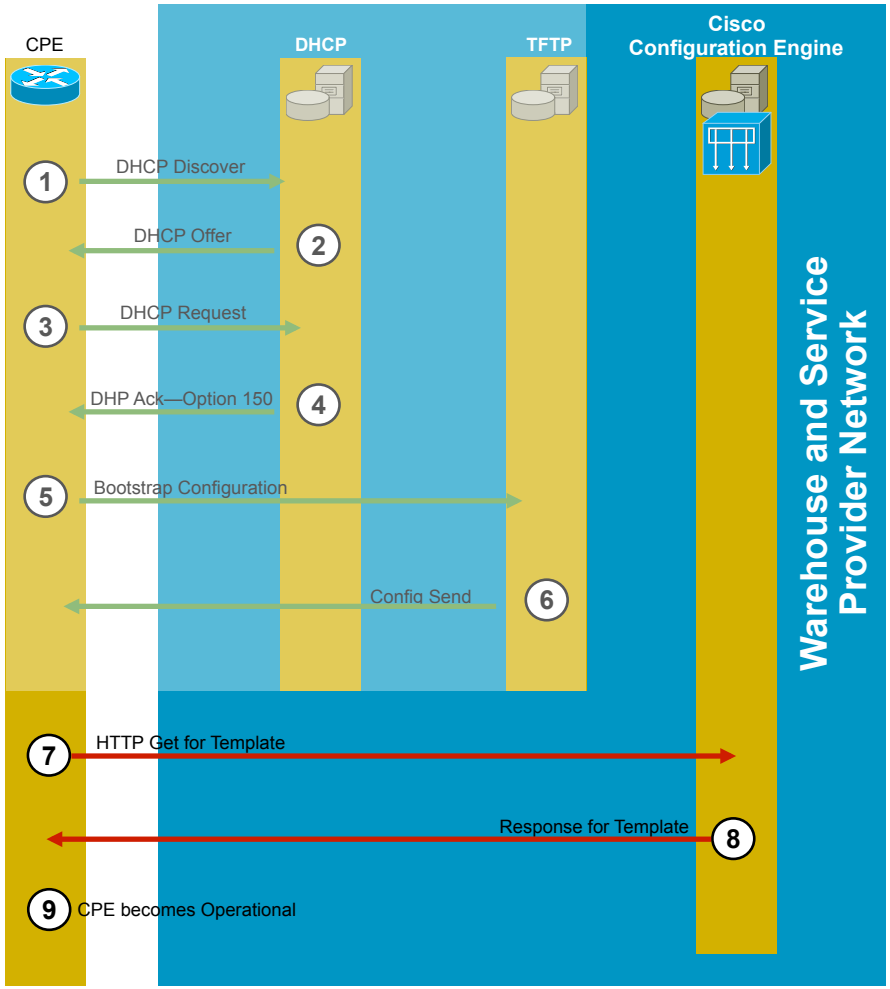
True Zero Touch Deployment Sequence



1. CPE sends Dynamic Host Configuration Protocol (DHCP) Discover
2. DHCP server replies with Offer
3. CPE sends DHCP Request
4. DHCP server replies with Option 150
5. CPE requests bootstrap file over TFTP
11. TFTP server sends CPE bootstrap file
12. CPE requests config template
13. CE responds with the template
14. CPE is operational

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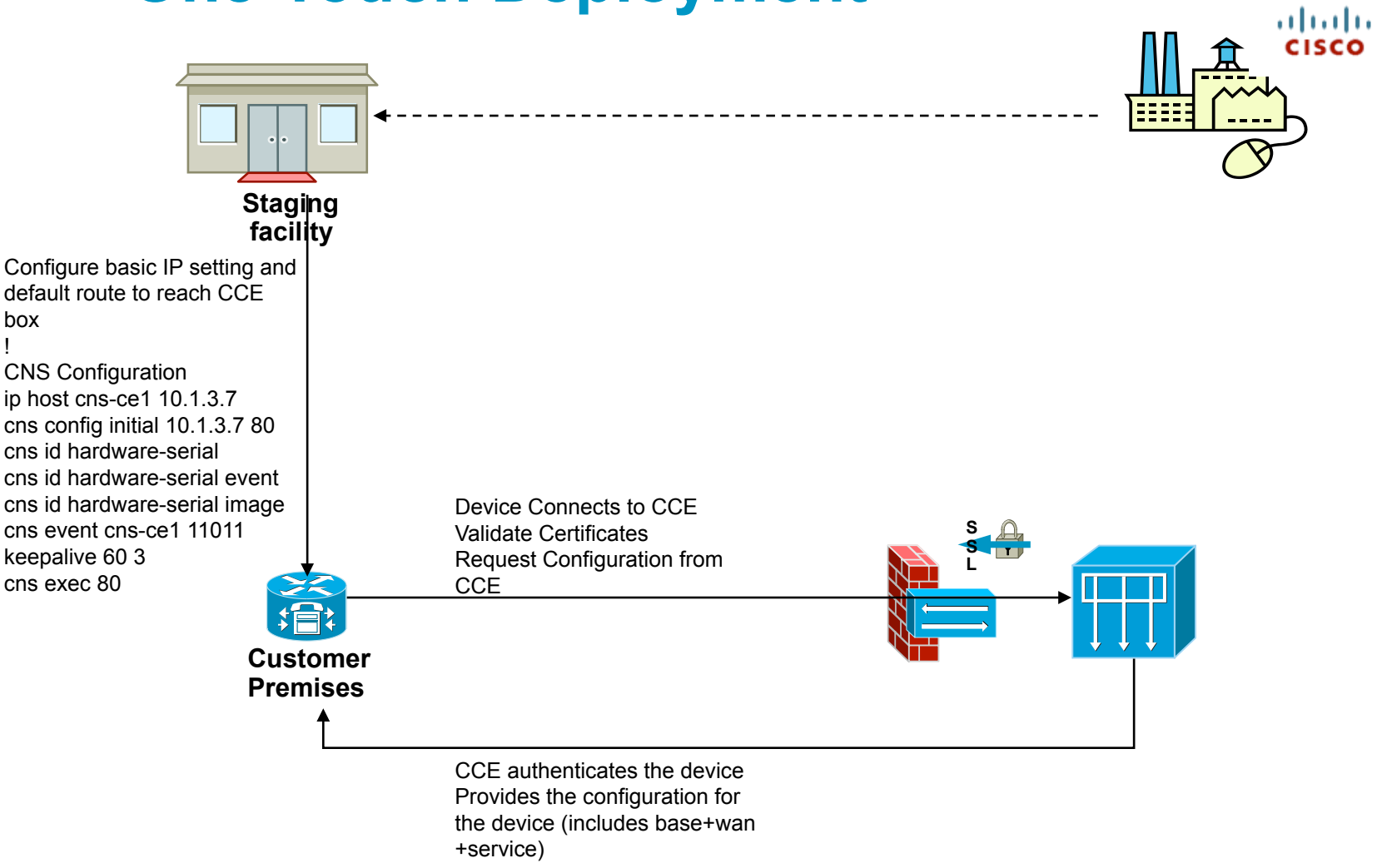
Deployment Model with CCE (2)
One-Touch Deployment



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Bootstrap Options

- Traditional staging
  - Manual or script
  - **Same** bootstrap configuration for all devices
- USB token
  - Load bootstrap from a USB key, if supported
- Configuration express
  - Cisco manufacturing loads bootstrap before shipping
- Remote user GUI
  - A GUI application to allow remote users to upload bootstrap
- Autoinstall

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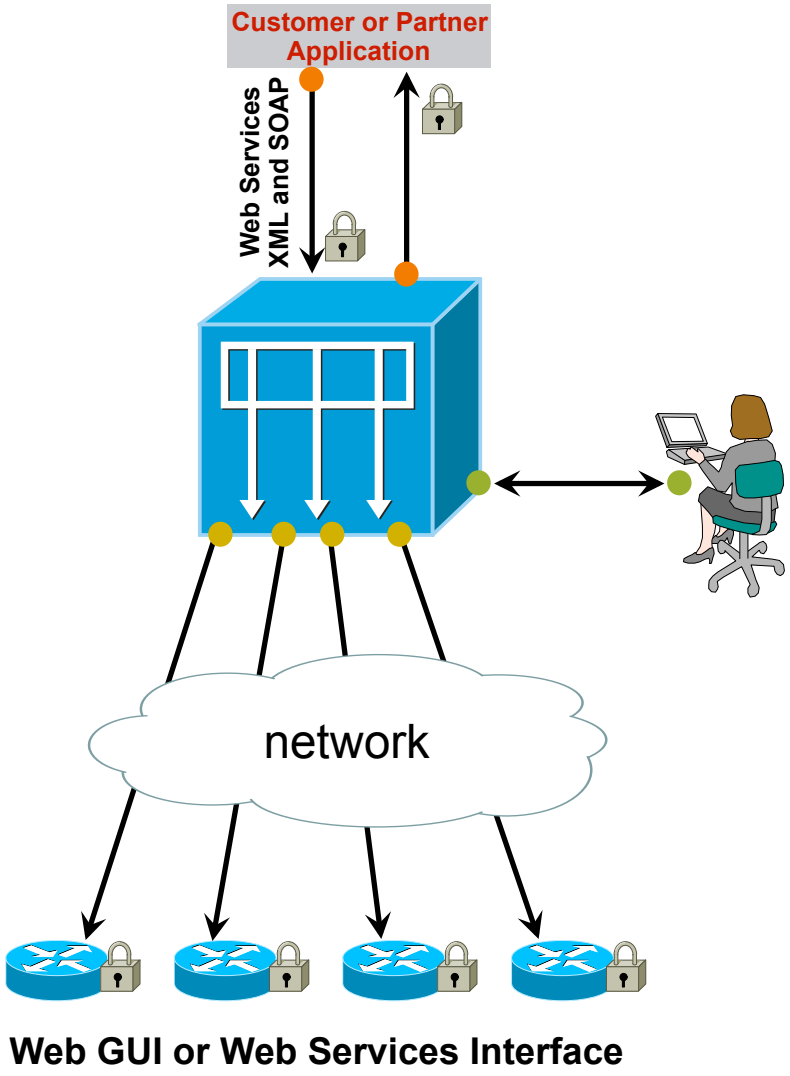
Beyond Initial Deployment
Configuration and Image Services

- Configuration Changes
  - Secure configuration updates to thousands of devices in minutes
  - Secure distribution of service configuration (voice, VPN, and security)
- Image Distribution
  - Cisco IOS Software images, Cisco Catalyst software images, intrusion protection system (IPS) files, Cisco Security Manager files, Cisco IP Phone images, music-on-hold (MOH) files, interactive voice response (TCL IVR) files, and more
- Image Activation: Any File, Anywhere
  - Cisco IOS Software and Cisco Catalyst software images can be activated and the device reloaded and verified
  - Configuration commands can be applied immediately prior to image activation



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Support for Platforms Other than Cisco IOS Software Network Services or Other Cisco Platforms

Device Development Module (IMGW)

- Device Communication Driver

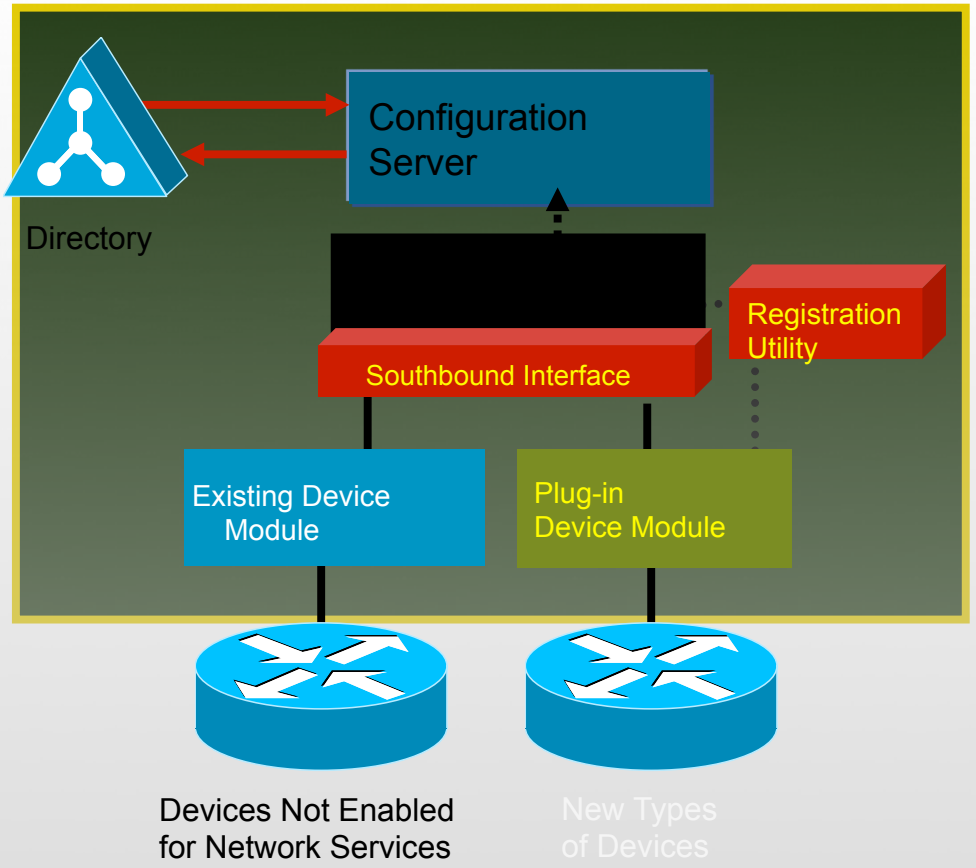
  Extend configuration engine to support protocol native to the device (Telnet, SSH, HTTP, TL1, etc.)

  Enable customers to develop their own scripts and communicate with devices not supported by configuration engine

- Sample Applications

  Non-IP: Develop module to communicate to the devices through modem or console server and use all product functions available through GUI or API

  Third-party devices: Extend configuration engine functions to support third-party devices and platforms



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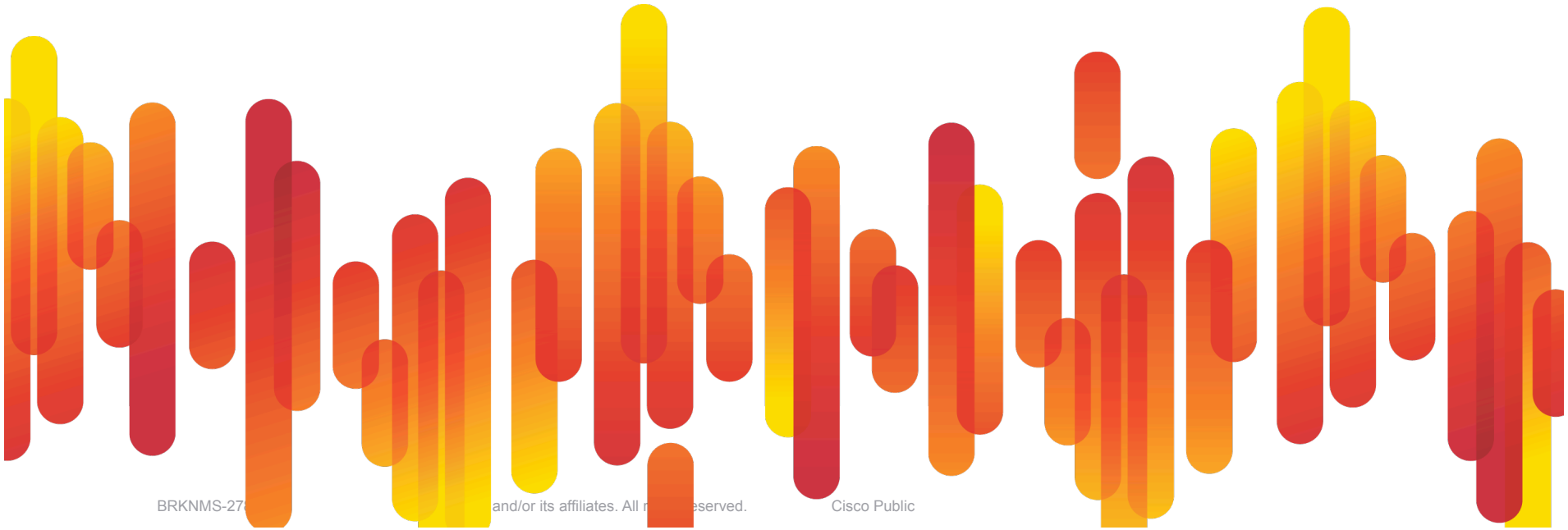
CCE Deployment Consideration



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Configuration Engine Recommended Hardware

Linux Platform: Red Hat v4.0 & v5.0

Recommended Specifications (20,000 Devices)

- CPU: Intel Xeon Processors 4 @ 2.33 GHz
- RAM: 4 GB
- Hard drive: 72 GB

Minimum Specifications (5,000 Devices)

- CPU: Intel Pentium III
- RAM: 1 GB
- Hard drive: 40 GB

Solaris Platform: Solaris 10

Recommended Specifications (30,000 Devices)

- CPU: Sun T1000 with 8 core, 1.0 GHz UltraSPARC T1 Processor
- RAM: 16 GB
- Hard drive: 146 GB 10K RPM SAS drive

Minimum Specifications (10,000 Devices)

- CPU: Sun Sparc
- RAM: 1 GB
- Hard drive: 40 GB

VMWare

Recommended Specifications

Guest OS specification same as Linux Platform.

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Deployment Consideration

- Support external LDAP for ease of sharing devices database
- Load sharing with an external load balancer (such as ACE) to achieve even higher scales
- Highly available operation (with load balancer)
  - Support both n+1 and 1+1 deployment model
  - Redundancy setup is completely transparent to the day-to-day operation of the Configuration Engine
  - Failover to the standby is automatic

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Consistent configuration deployment process is a primary requirement for successful management of a service

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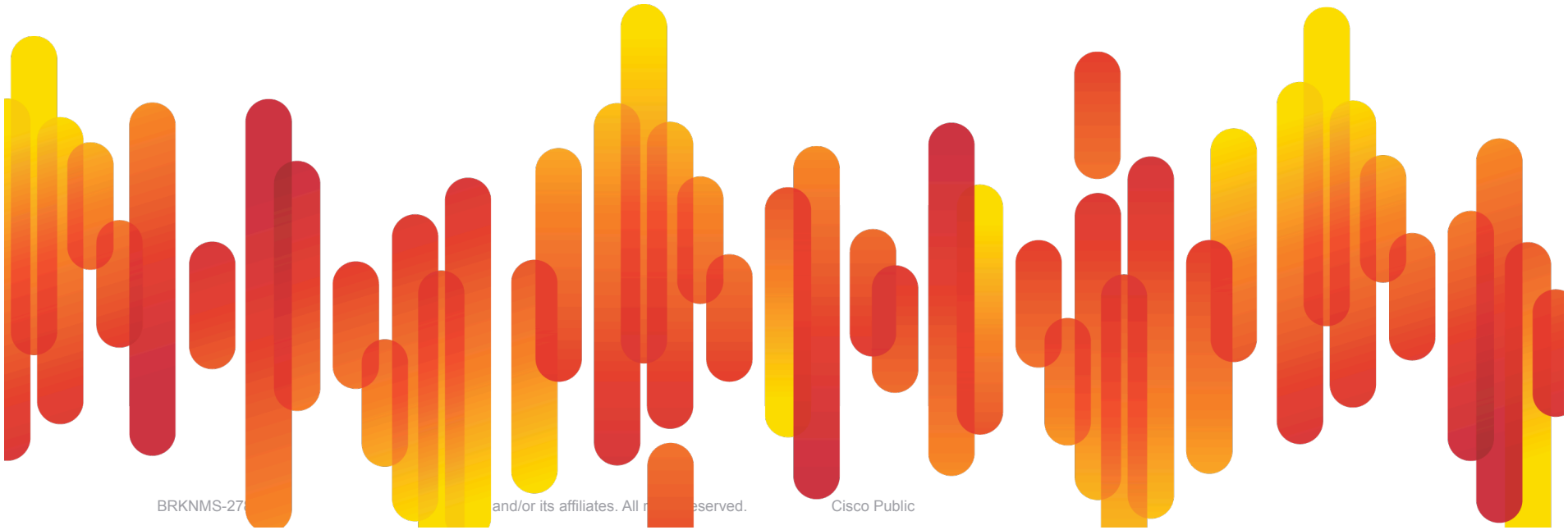
CCE Templates for Device Configuration



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Templates

- Templates allows the customer to create parameterized service configuration, which could then be used for configuration of the CPEs
- CCE supports two types of templating mechanism
  - Legacy templating mechanism
    - Direct IOS commands are used
    - Parameters can be substituted where ever user input is required (No manipulations allowed)
    - Suited for simple configurations
  - Velocity templating mechanism
    - Industry standard and equivalent to scripting
    - Parameters are supported and logical actions can be taken based on user input
    - Suited for sophisticated service configurations

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Template Parameters

- Template parameters allow the user to provide the values for each device. Device configuration is generated with the user provided parameter values
- CCE provides the capability to define new parameters based on service requirements
- Optionally, parameter validation rules can be associated to prevent user input errors
- Out-of-the-box validation rules are available; custom validation rules can also be created

  Example: IP address, numeric only, etc.,

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Legacy Templates: Example

hostname **${LDAP://this:attrName=IOShostname}**
!
interface **%FastEthernet 0%**
description **${LDAP://this:attrName=IOSwandescription}**
ip address **${LDAP://this:attrName=IOSwanipaddress}** **${LDAP://this:attrName=IOSwannetmask}**
speed **${LDAP://this:attrName=IOSintfspeed}**
duplex **${LDAP://this:attrName=IOSduplex}**
no ip directed-broadcast
no ip redirects
no ip proxy-arp
no shutdown
load-interval 30
no cdp enable
!
snmp-server community **${LDAP://this:attrName=IOSsnmpcommunity1}** view SNMPbugfix RO 99
snmp-server community **${LDAP://this:attrName=IOSsnmpcommunity2}** view SNMPbugfix RO 99
snmp-server community **${LDAP://this:attrName=IOSsnmpcommunity3}** view SNMPbugfix RO 99
snmp-server community **${LDAP://this:attrName=IOSsnmpcommunity4}** view SNMPbugfix RO 99
snmp-server community **${LDAP://this:attrName=IOSsnmpcommunity5}** view SNMPbugfix RO 99
!
snmp-server location **${LDAP://this:attrName=IOSlocation}**
snmp-server contact **${LDAP://this:attrName=IOScontact}**

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Legacy Templates: Output

- Parameter Screen

Parameter Name	Parameter Value
IOScontact	Jothi
IOSduplex	auto
IOShostname	Test-2800
IOSintfspeed	auto
IOSlocation	SanJose
IOSsnmpcommunity1	public
IOSsnmpcommunity2	private
IOSsnmpcommunity3	test
IOSsnmpcommunity4	custom1
IOSsnmpcommunity5	custom2
IOSwandescription	==WAN Interface for cust
IOSwanipaddress	172.16.0.1
IOSwannetmask	255.255.255.0

Save Reset

- Config Preview

```
hostname Test-2800
interface %FastEthernet 0%
description ==WAN Interface for customer===
ip address 172.16.0.1 255.255.255.0
speed auto
duplex auto
no ip directed-broadcast
no ip redirects
no ip proxy-arp
no shutdown
load-interval 30
no cdp enable
snmp-server community public view SNMPbugfix RO 99
snmp-server community private view SNMPbugfix RO 99
snmp-server community test view SNMPbugfix RO 99
snmp-server community custom1 view SNMPbugfix RO 99
snmp-server community custom2 view SNMPbugfix RO 99
snmp-server location SanJose
snmp-server contact Jothi
```


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Velocity Templates

- Enables user customization based on device configuration and service activation requirements
- Supports Java, Perl, Expect, and other scripting tools
- Enables customers to generate configuration dynamically through interaction with the device
- Enables customers to develop and plug in scripts to validate device attributes entered by network operations center staff
- Supports scripts to autopopulate attribute values retrieved from customer's data repository
- Provides native support for
  - Variables
  - Nested conditions
  - Compound conditions
  - Loops
  - Range operators
- Velocity user guide: http://jakarta.apache.org/velocity/user-guide.html

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Velocity Templates: Variables and Logical Conditions

Variables

```
#set( $vpi = 101 ) - Digits
#set( $encap = "aal5snap" ) - Strings
#set( $subnetmask = "$!
{dsobj.getValue('IOSipaddress')}")
–  Substitute template attribute
```

Nested Conditions

```
#if ( $ip_address_needed == "YES" )
    ip address 10.10.1.1 255.255.255.0
    #if ( $no_atm_keepalive == "YES")
        no atm ilmi-keepalive
    #end
#else
    no ip address
#end
```

Compound Conditions

```
#if ( $ip_address_needed == "YES" &&
$no_atm_keepalive == "YES")
    ip address 10.10.1.1 255.255.255.0
    no atm ilmi-keepalive
#else
    no ip address
#end
```

Loops and Range Operators

```
#set( $ip_digits = [1..10] )
#foreach( $ip_d in $ip_digits )
    ip route 30.0.0.$ip_d 255.255.255.255 10.0.0.2
#end
```


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Velocity Templates: Example

```
#set( $wanDescription = $!{dsobj.getValue('IOSwandescription')} )
#set( $wanIPAddress = $!{dsobj.getValue('IOSwanipaddress')} )
#set( $wanNetmask = $!{dsobj.getValue('IOSwannetmask')} )
#set( $intfSpeed = $!{dsobj.getValue('IOSintfspeed')} )
#set( $duplex = $!{dsobj.getValue('IOSduplex')} )
!
interface FastEthernet 0/0
description $wanDescription
ip address $wanIPAddress $wanNetmask
speed $intfSpeed
duplex $duplex
no ip directed-broadcast
no shutdown
load-interval 30
no cdp enable
!
#if($snmpComm1 != "")
  snmp-server community $snmpComm1 view SNMPbugfix RO 99
#end
#if($snmpComm2 != "")
  snmp-server community $snmpComm2 view SNMPbugfix RO 99
#end
!
#set($fxsPortList=[0..$count])
#set($dpid = 1)
#foreach($port in $fxsPortList)
   dial-peer voice $dpid pots
   service mgcpapp
   port 2/$port
  #set($dpid=$dpid+1)
#end
```


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Velocity Templates: Java Script Functions

- Calling Java Script from Velocity Templates

```
##Invoke Javascript function to generate market specific base configuration

#if ($market == “SFO" || $market == “sfo")

  $js.invoke(“sanfrancisco.io.vm", “SANFRANCISCO")

#elseif ($market == “SJC" || $market == “sjc")

  $js.invoke(“sanjose.io.vm", “SANJOSE")

#end
!
##End Javascript call
```

- Sample Java Script

```
if (snmpComm1 != "") {
        println("snmp-server community " + snmpComm1 + " view SNMPbugfix RO 99");
}
if (snmpComm2 != "") {
     println("snmp-server community " + snmpComm2 + " view SNMPbugfix RO 99");
}
if (snmpComm3 != "") {
        println("snmp-server community " + snmpComm3 + " view SNMPbugfix RO 99");
}
if (snmpComm4 != "") {
        println("snmp-server community " + snmpComm4 + " view SNMPbugfix RO 99");
}
if (snmpComm5 != "") {
        println("snmp-server community " + snmpComm5 + " view SNMPbugfix RO 99");
}
```


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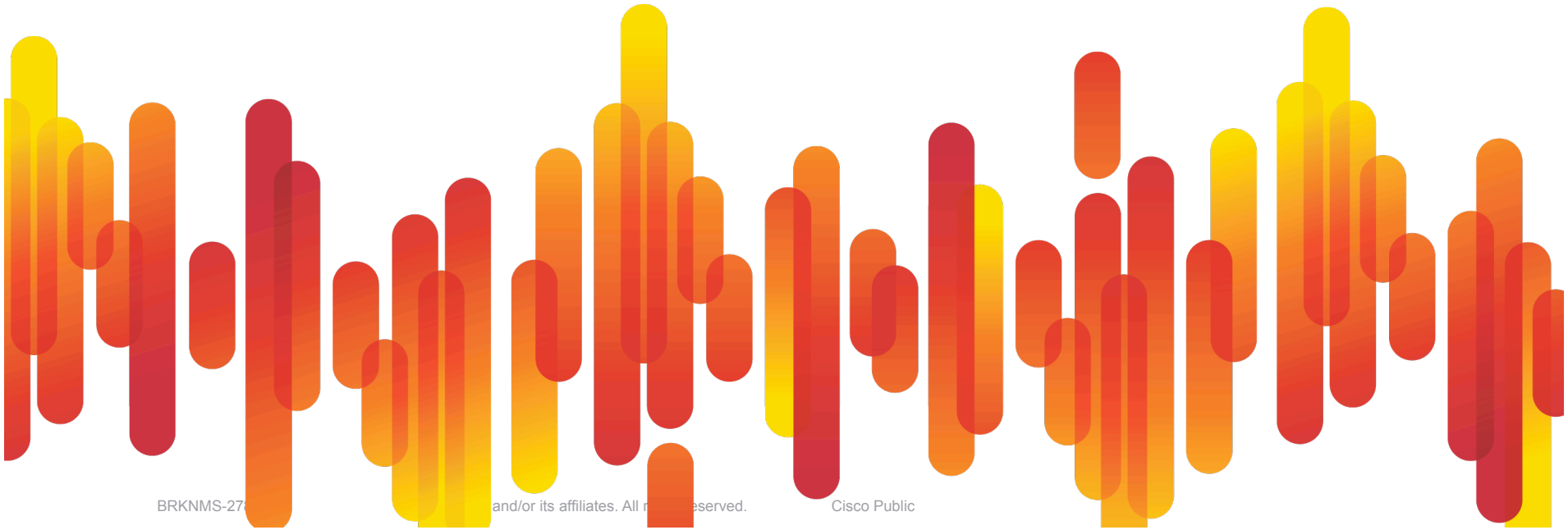
Using Web Services for North Bound Integration



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CCE Web Services Overview

- Provides standards-based programmatic access to configuration engine
- Combines WSDL and client library approaches
- Packaged as a separate configuration engine SDK sister product
- Available web services:

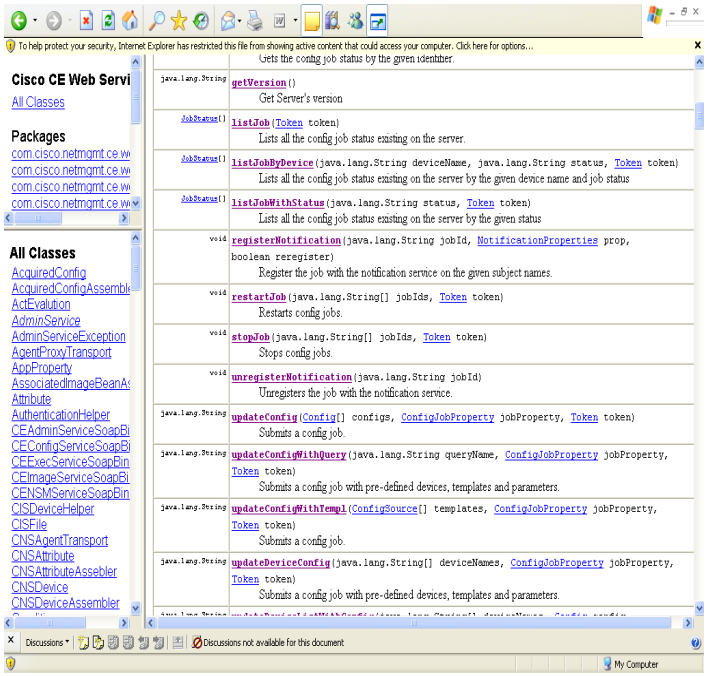
  ConfigService: Send and acquire configurations to and from devices

  ImageService: Distribute and activate images, obtain hardware inventory and file systems, and delete files

  ExecService: Execute show commands and reload devices

  AdminService: Create and manage system objects used by configuration engine to manage devices (devices, users, groups, templates, etc.)

  NSMService: Manage namespace and subjects and subject mappings in namespace


Cisco CE Web Servi
All Classes
Packages
All Classes
getVersion()
Get Server's version
listJob(Token token)
Lists all the config job status existing on the server.
listJobByDevice(java.lang.String deviceName, java.lang.String status, Token token)
Lists all the config job status existing on the server by the given device name and job status
listJobWithStatus(java.lang.String status, Token token)
Lists all the config job status existing on the server by the given status
registerNotification(java.lang.String jobId, NotificationProperties prop, boolean reregister)
Register the job with the notification service on the given subject names.
restartJob(java.lang.String[] jobIds, Token token)
Restarts config jobs.
stopJob(java.lang.String[] jobIds, Token token)
Stops config jobs.
unregisterNotification(java.lang.String jobId)
Unregisters the job with the notification service.
updateConfig(Config[] configs, ConfigJobProperty jobProperty, Token token)
Submits a config job.
updateConfigWithQuery(java.lang.String queryName, ConfigJobProperty jobProperty, Token token)
Submits a config job with pre-defined devices, templates and parameters.
updateConfigWithTempl(ConfigSource[] templates, ConfigJobProperty jobProperty, Token token)
Submits a config job.
updateDeviceConfig(java.lang.String[] deviceNames, ConfigJobProperty jobProperty, Token token)
Submits a config job with pre-defined devices, templates and parameters.

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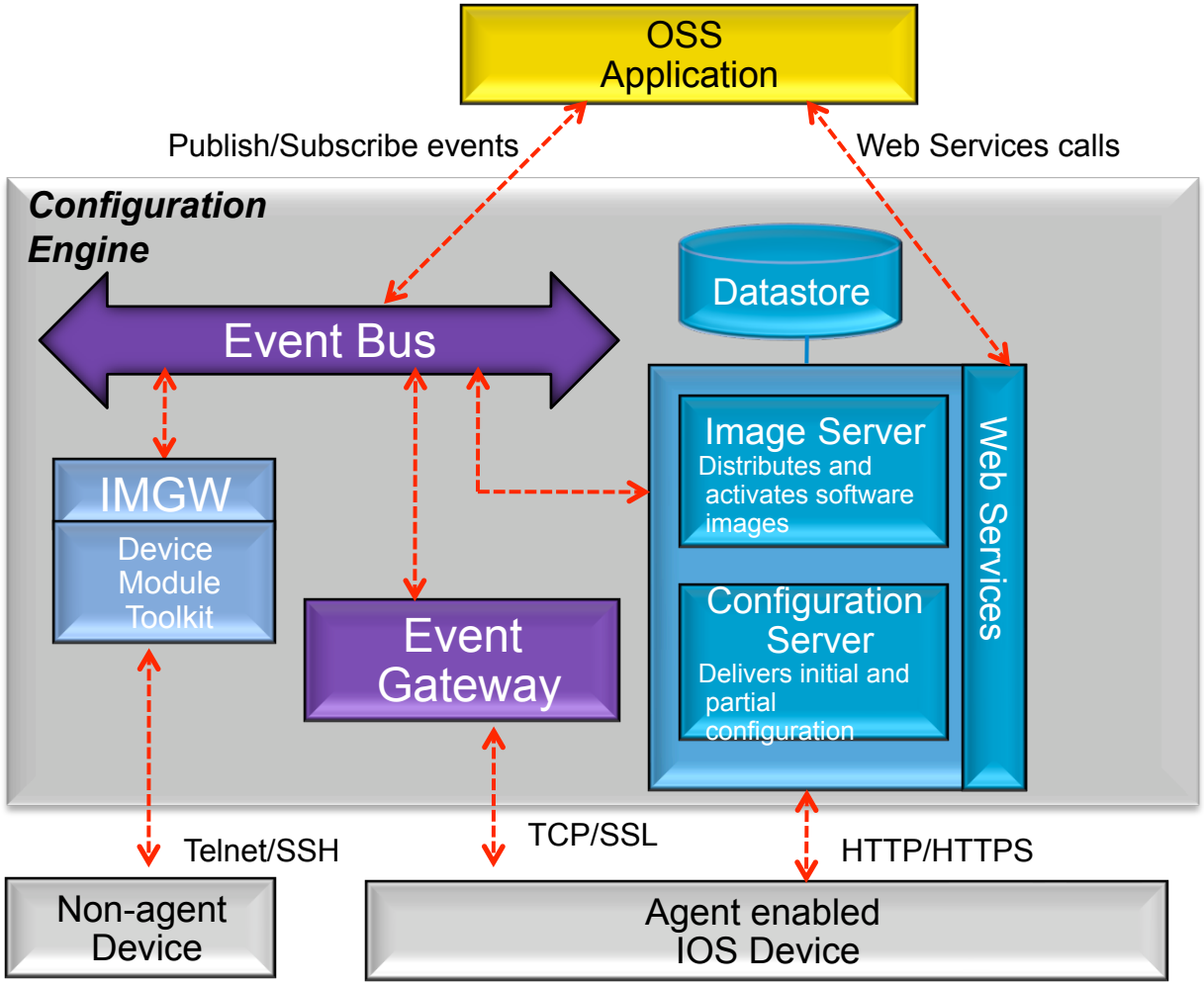
Webservice Architecture



OSS apps can integrate with CE in two ways:

- Event services
- Web services

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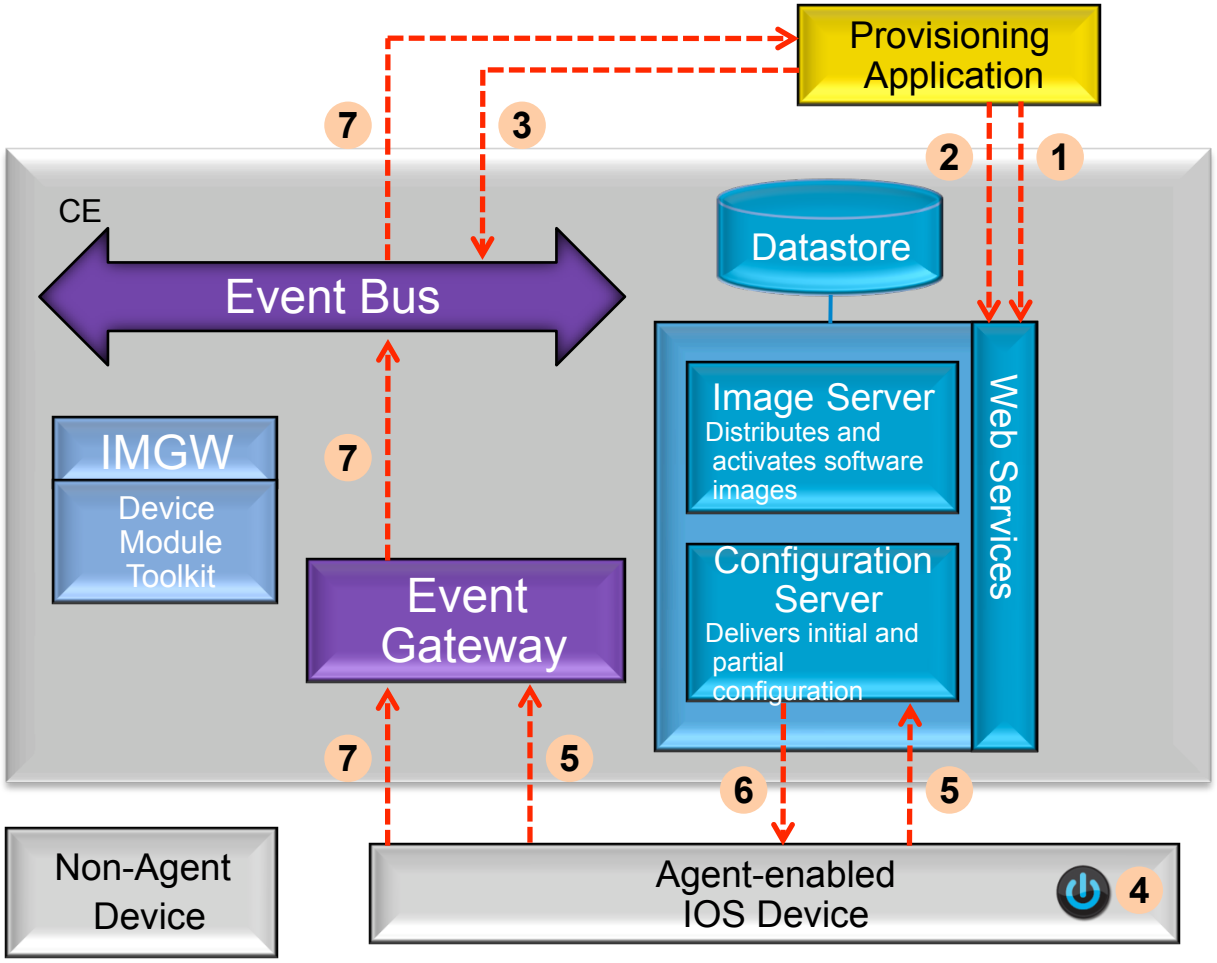
Zero Touch Using Webservice APIs



1. Provisioning application creates the device in CCE

2. Associate template with this device.

3. Subscribe events sent by the device

4. Power on device; device contact DHCP to get TFTP IP; device download and applies bootstrap config

5. Device initiates connection to CE to get config

6. Device gets and applies the config

7. Device notifies CE the config status; event gateway forward notification; provisioning application receives the event.

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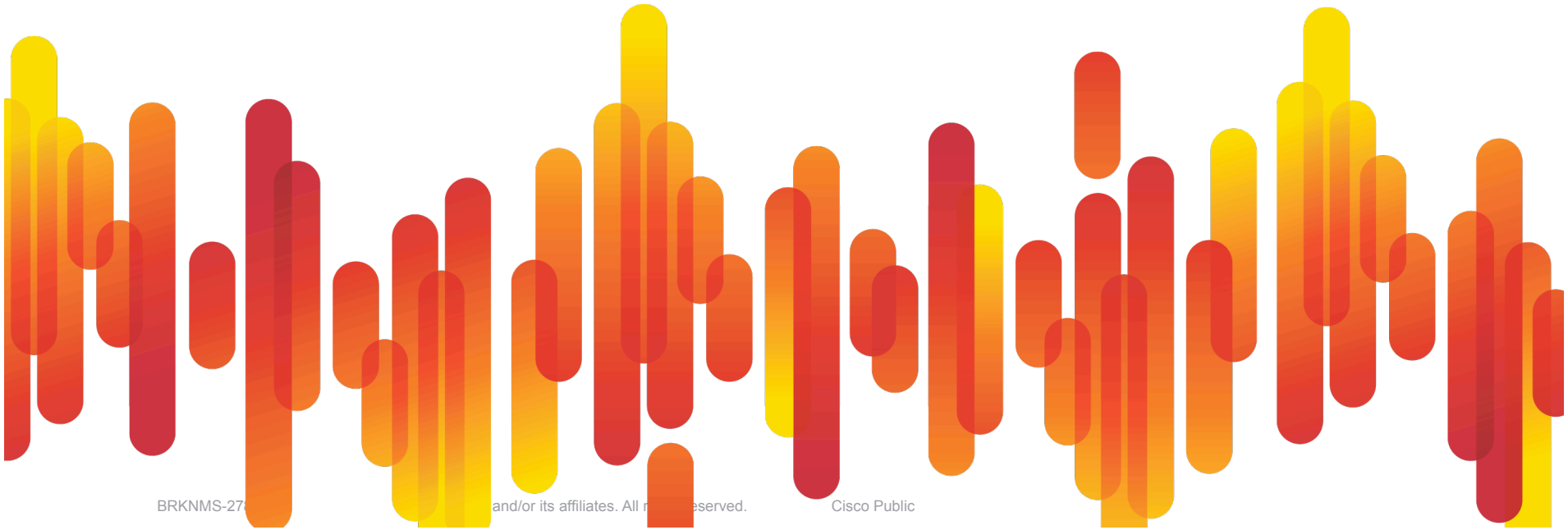
Case Studies



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US Service Provider—Managed Voice Service

- Service provider offers managed voice and data services using Cisco IAD 243x series
- Customer can choose from different tiers of the offering
- Geographically dispersed deployment with specific configuration for each major city/market
- Prior to CCE deployment Cisco IAD configuration was done by copy and paste of information from spreadsheet
- No standard provisioning and configuration management process was in place

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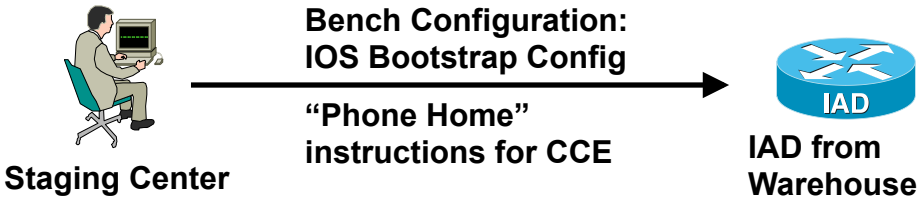
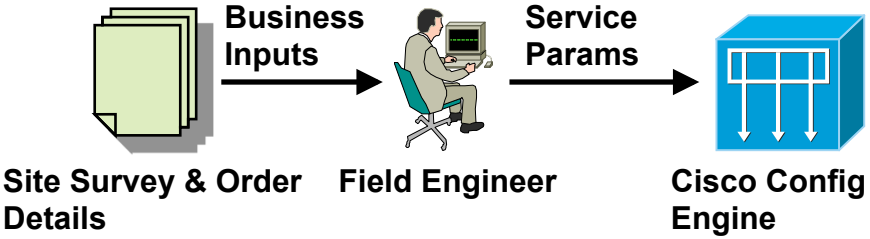
How Cisco Config Engine Was Used? Phase-1

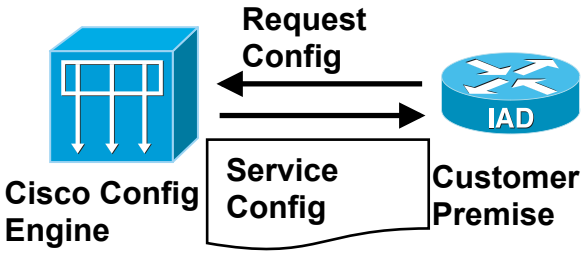
Step 1:
Bootstrap Config



Step 2:
Device Configuration



Step 3:
Installation Truck Roll



Step 4:
Backup Running Config in Ciscoworks

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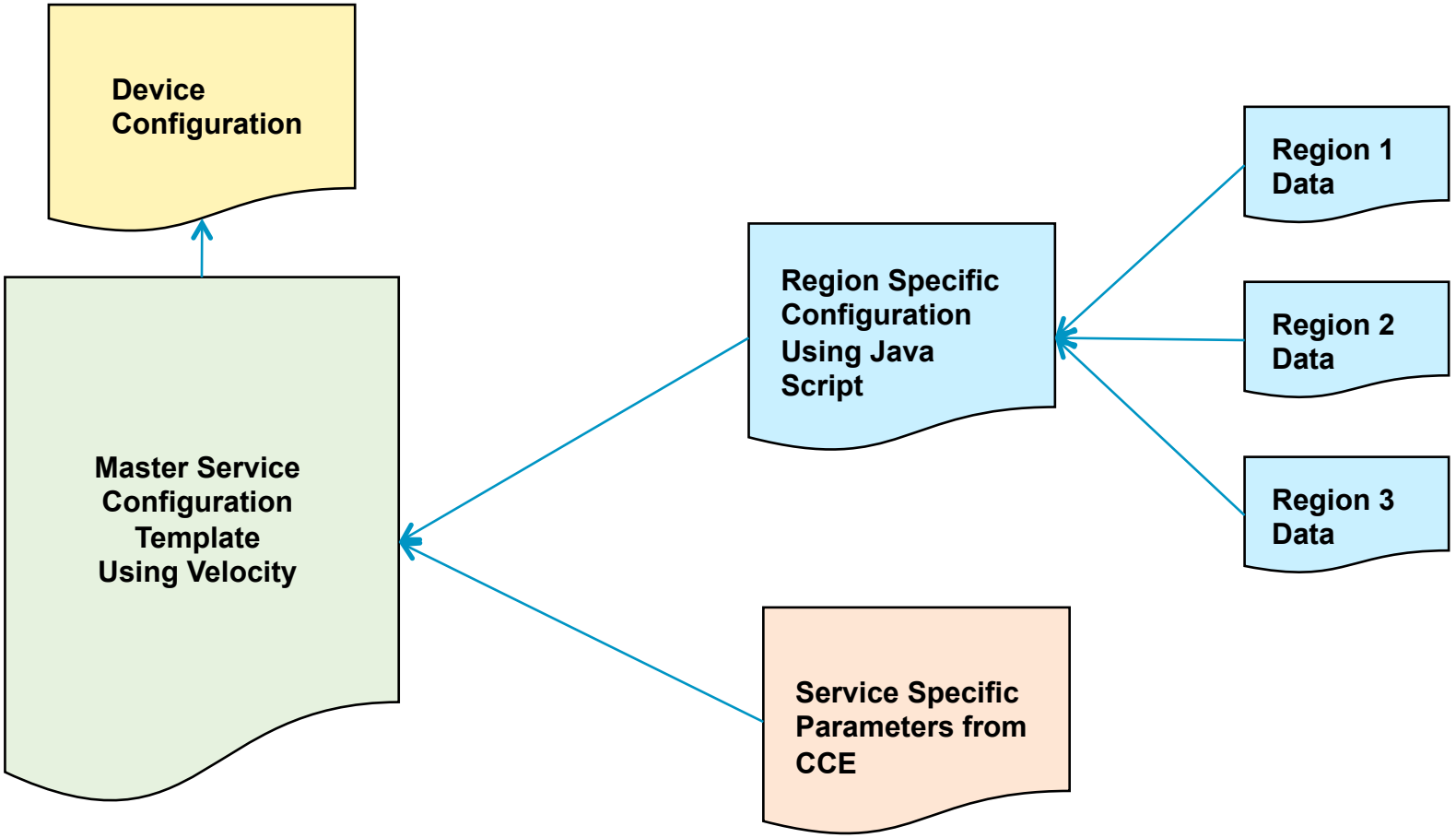
How Velocity Templates Were Used? Phase-1


Device Configuration
Master Service Configuration Template Using Velocity
Region Specific Configuration Using Java Script
Region 1 Data
Region 2 Data
Region 3 Data
Service Specific Parameters from CCE

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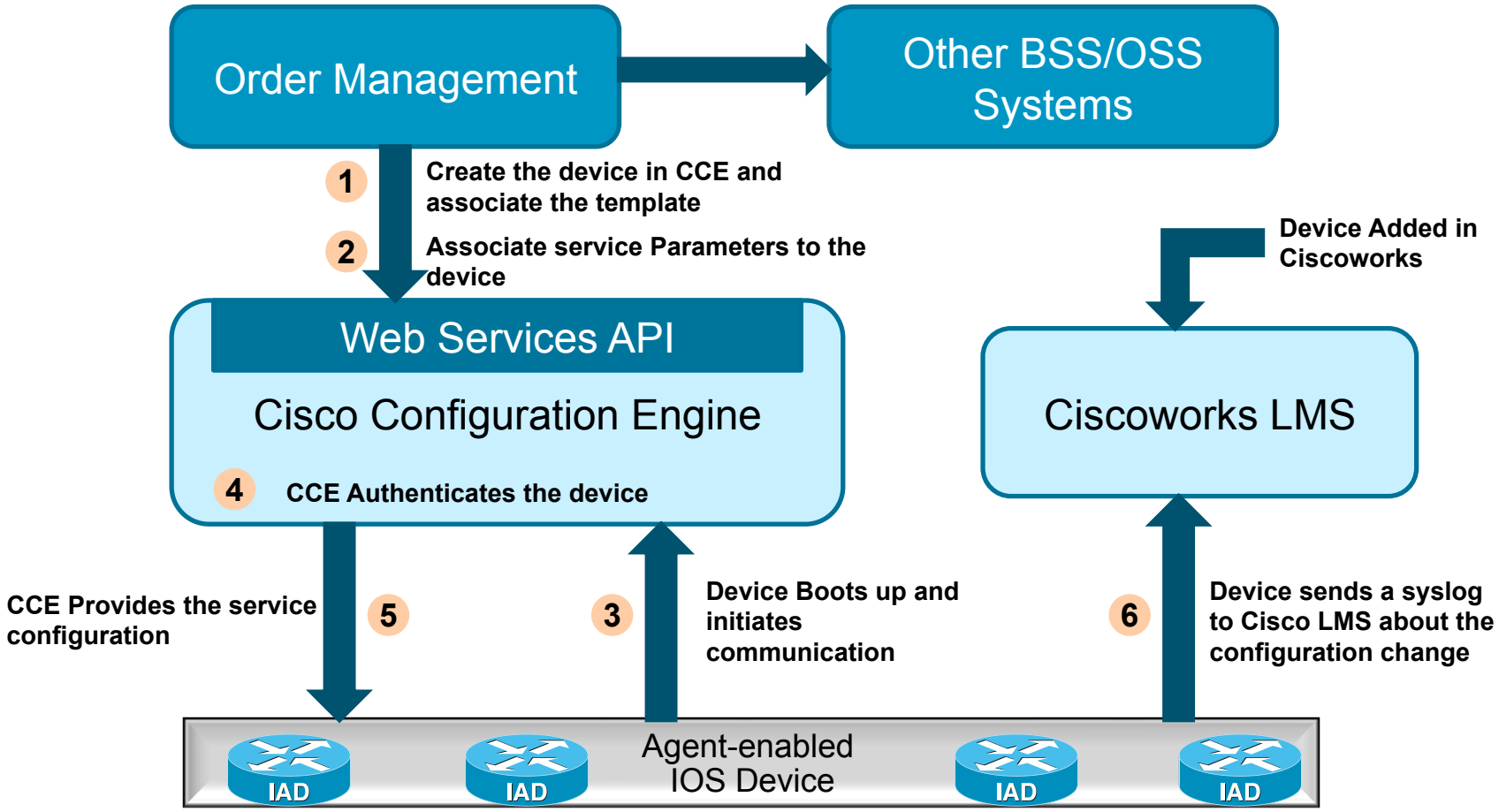
How Web Service Interface Was Used? Phase-2



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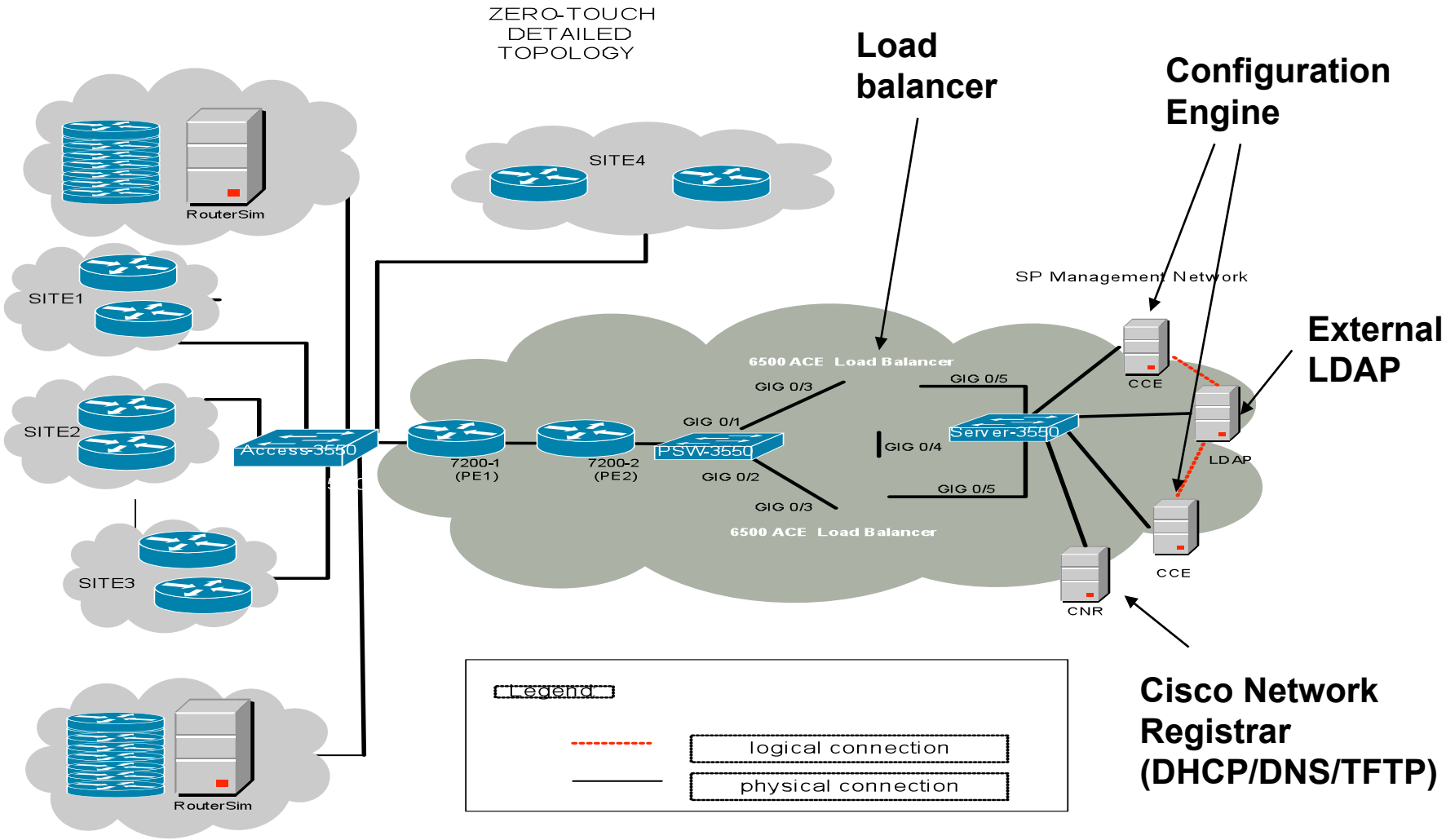
Cisco Validated Design
Zero-Touch Deployment Solution



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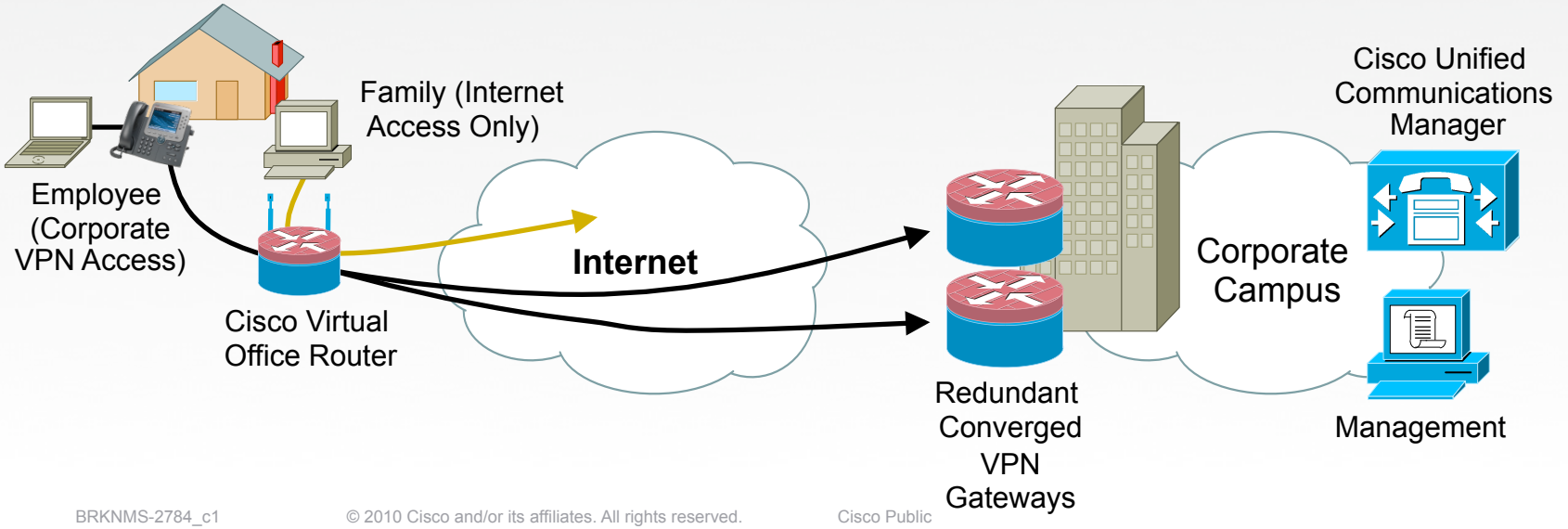
Cisco Validated Design

Cisco Virtual Office

- Cisco Virtual Office is an end-to-end solution for employees that work in remote locations including branch and home offices
- Cisco IT uses this solution

  Deployed 17,000, plan to expand to 30,000
- The solution features office-caliber end-user experience with voice, video, wireless, and real-time data
- Integrated security protects the employee and the corporate network



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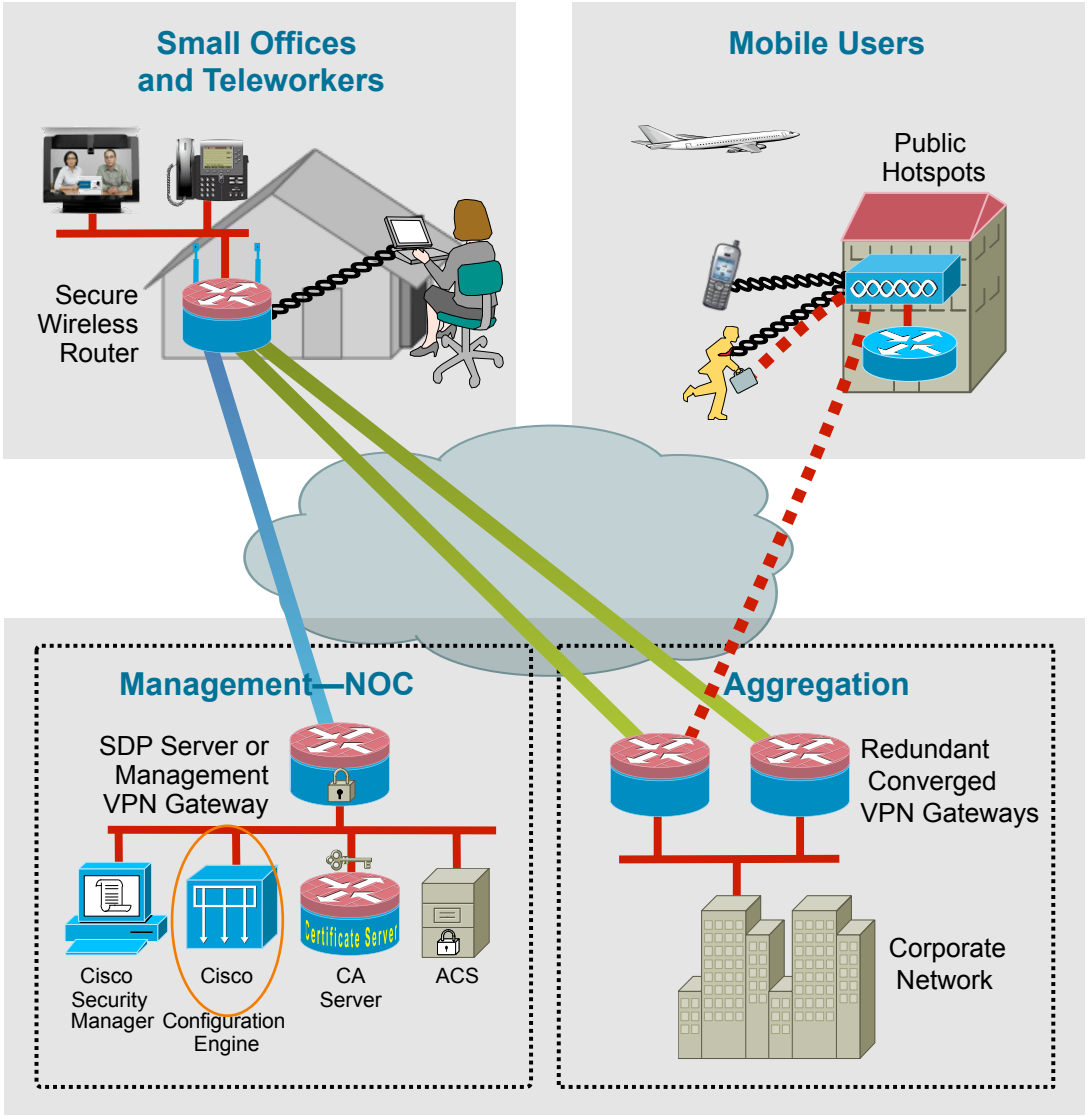
Cisco Virtual Office Architecture



- Cisco Security Manager is used to generate configurations for individual user.
- Cisco Configuration Engine is used to distribute configuration as well as image upgrade.
- A couple of 3845s are used for DHCP as well as security certificate management.
- Remote routers can be shipped directly to end user with factory defaults or staged
- Architecture allows for outsourcing of NOC to separate IT entity

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CCE Demo

NMS Sessions Offered (1 of 2)

Session	Title
BRKNMS-1030	ITIL v3 Foundation and Enhanced Telecom Operations Map (eTOM) frameworks
BRKNMS-1031	Network Health Framework - A proactive solution for network health improvement
BRKNMS-1204	Introduction to Network Performance Measurement with Cisco IOS IP Service Level Agent
BRKNMS-1532	Introduction to Accounting Principles and NetFlow
BRKNMS-1640	Advanced DHCP and DNS Deployments
BRKNMS-1831	Network Performance Management: A proactive End-to-End approach
BRKNMS-1942	Managing Infrastructure as a Service (IaaS) for a Cloud environment
BRKNMS-2022	UC Network Management: How to Ensure Your UC Services are Operating as Expected
BRKNMS-2025	Cisco Network Optimization

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NMS Sessions Offered (2 of 2)

Session	Title
BRKNMS-2030	Onboard Automation with Cisco IOS Embedded Event Manager
BRKNMS-2031	SYSLOG Design, Methodology and Best Practices
BRKNMS-2032	DHCP and DNS for Large Scale Network Architectures and Cloud Computing
BRKNMS-2361	Accounting and Performance Management with Network Based Application Recognition
BRKNMS-2658	Securely Managing Your Networks and SNMPv3
BRKNMS-2784	Automatic Configuration Deployment using CCE
BRKNMS-3021	Advanced Cisco IOS Device Instrumentation
BRKNMS-3043	Advanced Performance Measurement for Critical IP Traffic with Cisco IOS IP Service Level Agreements
BRKNMS-3132	Advanced Netflow
PNLNMS-3000	Implementing Effective Day-2 Network Operations Support with ITIL

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CISCO